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(58) continued overleaf

(54) Industrial textile including photochromic material

(57) An industrial textile, such as an industrial belt or filter e.g. a press felt for papermaking, is composed of a polymer matrix incorporating photochromic dyes. The photochromic dyes reversibly change colour typically when exposed to ultra violet light. Incorporation of the photochromic dyes having a characteristic colour change in the polymer matrix of an industrial textile allows wear of that particular textile to be simply and efficiently identified since only fibres shedded from that textile will exhibit the characteristic colour change when exposed to ultra violet light. In this manner, those fibres shedded from a particular industrial textile may be easily distinguished from those fibres of other textiles by the particular colour change displayed and thus shedded fibres may be simply, yet effectively identified as those from a particular textile of a particular manufacturer. The dyes may be included in the fibres or yarn from which the textile is made or in a coating.

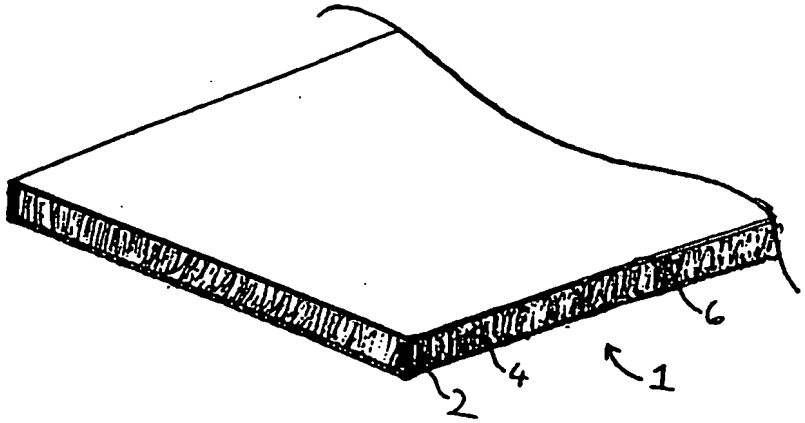

Figure 1

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

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(58) Field of Search

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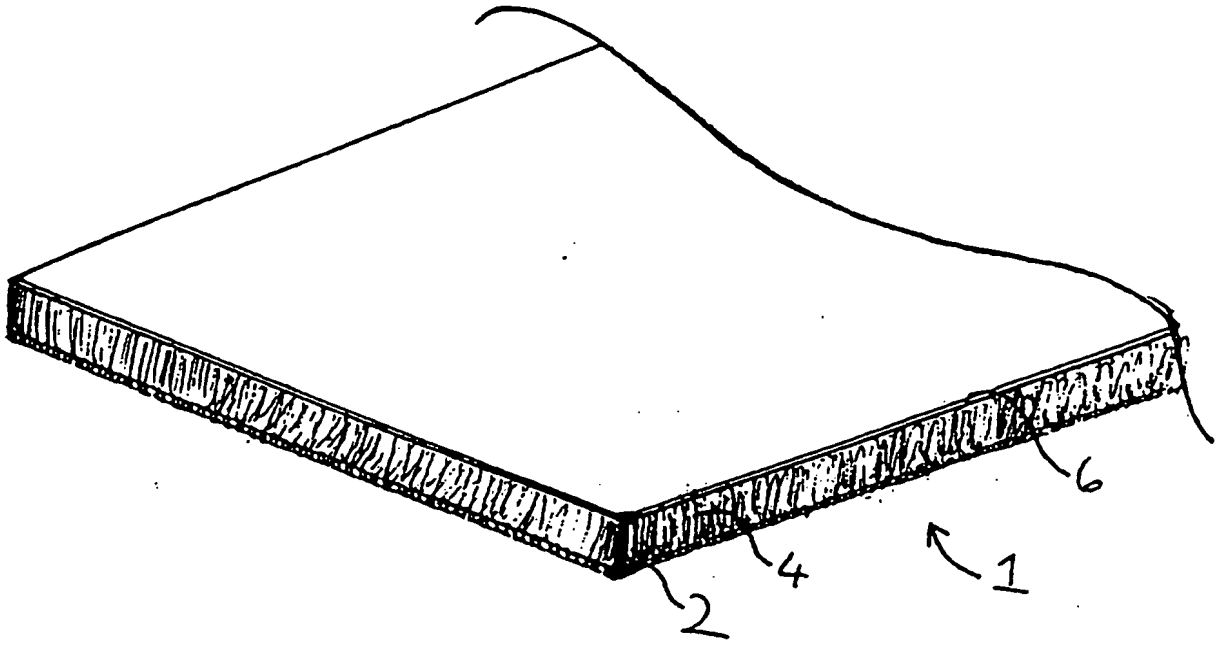

Figure 1

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Industrial Textiles

The present invention relates to industrial textiles and has particular application in the fields of industrial belting and phase separation media, for example belts used in paper-making and filters.

Textiles of a wide variety of forms and uses in various applications all suffer from and create further problems from wear during use. For example, textiles comprising moulded polymer structures, substrates with a coating of resin or polymer or fibre-based textiles all shed particles during use which create problems For example, felts used for industrial belting and phase separation media shed fibres due to their wear during use. This so-called fibre shedding increases with the age of the textile. Such shedded fibres cause much wastage in processes using industrial textiles by contaminating the products of that process. For example, in the paper making process, shedded fibres from needle-felt based press felts frequently contaminate the moist paper web supported by the felt resulting in the paper sheet produced having to be discarded. Such contamination of products with shedded fibres from industrial textiles or shedded particles from other forms of industrial textiles occurs in a wide variety of processes that use industrial belts and/or phase separation media, such as filters, tobacco suction tapes, tobacco garniture tapes, conveyor belts, printing blankets, fusing belts, laminating blankets and transfer blankets.

Furthermore filaments which are used in a variety of applications may also suffer from particle shedding and will contaminate the products they

are in contact or close proximity with.

Typically those suffering wastage as a consequence of a particle-shedding industrial textile seek recompense from the manufacturers of the textile. However, since in general a production process uses numerous industrial textiles from various sources, it is usually difficult to determine from which textile particles are being shed and thus to identify from which industrial textile manufacturer recompense should be sought.

The present invention seeks to provide a simple yet effective means for identifying the source of particles shedded from industrial textiles.

According to a first aspect of the present invention there is provided an industrial textile optionally having a coating thereon, wherein the textile and/or coating comprises a polymer matrix wherein the polymeric matrix comprises at least one photochromic material. Such an industrial textile may have particular application as an industrial belt such as a press felt in a paper making process, or as a phase separation medium such as a filter.

The polymer matrix may be provided alone or in combination with a substrate. Preferably the polymer matrix is provided as a fibre, filament, yarn or the like or as a coating on a substrate. The substrate may be a base fibre, filament or yarn or the like. For example, where the industrial textile is a standard needle-felt based material for a felt press for use in paper making, the felt preferably comprises batt staple polymer fibres wherein the staple fibres comprise at least one photochromic material.

Photochromic materials are well known as materials which change

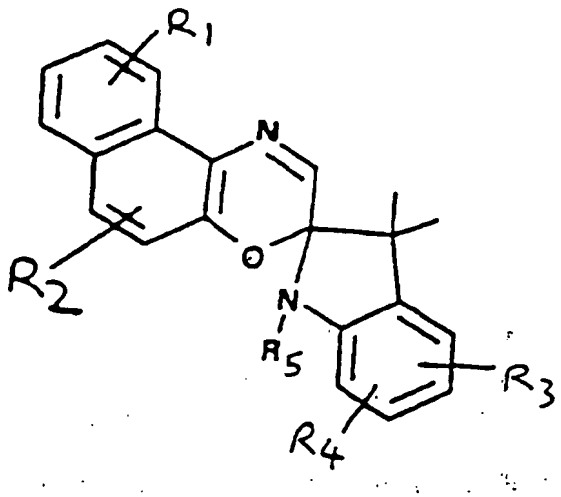
colour either reversibly or irreversibly when exposed to light. Generally, the colour change inducing light has a wavelength in the visible or near visible range and is typically ultraviolet light. Reversible photochromic materials revert back to their original colour in the absence of the colour-change inducing wavelength of light. In general terms, the colour change results from a photochemical reaction whereby exposure to the relevant wavelength of light (such as ultra-violet light) causes a change in chemical structure of the photochromic material turning it from a non-coloured or pale-coloured material to a more intensely coloured material. Generally the change in chemical structure is caused by breakage of at least one chemical bond in the photochromic material so altering its configuration. The reversion back to a non-coloured or pale-coloured form is generally driven by heat.

In general terms, any photochromic material that is stable to the conditions required to produce a polymer fibre, filament, yarn, coating etc. for preparing an industrial textile are useful in the present invention.

Preferably an industrial textile according to the present invention comprises a polymer matrix comprising 0.01 - 15% by weight of photochromic material, most preferably 0.1 - 5% by weight of photochromic material.

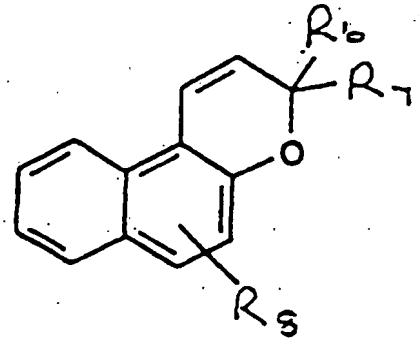
Preferably the industrial textile of the present invention comprises at least one photochromic material selected from a group of compounds represented by the following formulae:

A)



where R_1, R_2, R_3, R_4 are each hydrogen, halogen or lower alkyl and R_5 is hydrogen or lower alkyl, preferably methyl. Most preferably R1 - 4 groups are hydrogen, or R_1 and R_2 are hydrogen and R_3 and R_4 are methyl, or R_1 and R_2 are methyl and R_3 and R_4 are hydrogen, or R_1, R_3, R_4 are hydrogen and R_2 is halogen or lower alkyl; and/or

B)



where R_6 and R_7 are aryl groups optionally substituted with one or more groups such as lower alkyl or halogen atoms. R_8 is hydrogen, halogen or

lower alkyl. Most preferably R_6 and R_7 are phenyl, and R_8 is most preferably hydrogen, methyl or ethyl.

Selection of different substituent groups and different positions of the groups provides a wide variety of photochromic materials exhibiting different properties such as different colours and intensities of colour, speed of response to colour-change inducing light etc.

Preferably the photochromic material is micro encapsulated. Most preferably the micro-capsules comprise thermoplastic polymer material(s). Such micro-capsules that contain photo chromic materials are preferably incorporated into the polymer matrix of the industrial textile. The use of such micro-capsules advantageously improves the homogeneity of photochromic material distribution in the polymer matrix.

Suitable thermoplastic polymer encapsulating materials include polyolefins such as polypropylene, polyethylene, polyamides having a melt temperature of less than 250°C (preferably less than 230°C), such as nylon 6, 8, 12, 66 polyesters having a melt temperature of less than 250°C (preferably less than 230°C), and various mixtures thereof. The encapsulating materials preferably have a melt flow index greater than 15g/10 mins, ideally 25 - 60g/10 mins.

Other additives may be incorporated into the micro capsules and/or the polymer matrix to provide or enhance particular properties of the industrial textile. For example, enhancement agents may include ceramic particles to increase abrasion resistance, graphite, molybdenum disulphide

or vermiculite to increase lubricity, ormocer particles to improve resistance to abrasion and contamination, fluoropolymers for resistance to contamination and stabilisers/antioxidants such as Irganox (R.T.M.) 1330, Irganox 1098, Irgafos (R.T.M.) 168, Irganox B 1171, all of which comprise organic phosphoric or phosphinc acids, or their derivatives or salts.

The photochromic material(s) may be incorporated into a polymer matrix and this blend is then preferably processed to form a yarn, filament, fibre, coating or the like by any known methods. For example, US patent 5422181 describes a method of preparing synthetic fibres containing polymer encapsulated photochromic dyes by blending the dye capsules and polymer and extruding the mixture into fibres, filaments and yarns by melt-spinning and extrusion processes at a temperature which does not exceed 250°C.

Needle-felt based industrial textiles according to the present invention are preferably formed from staple fibres. The staple fibres comprise a polymer matrix preferably incorporating micro-encapsulated photochromic materials and are preferably formed by a melt-spinning process.

According to a second aspect of the present invention there is provided a method for producing an industrial textile optionally having a coating thereon wherein the textile and/or coating comprises a polymer matrix and wherein the polymeric matrix comprises at least one photochromic material, which method comprises the steps of

(a) forming a blend of a polymer matrix and at least one

photochromic material,

(b) melt-spinning or extruding that blend to form fibres/filaments/yarns or coatings containing photochromic material(s),

(c) processing the fibres/filaments/yarns to form industrial textiles and/or coating an industrial textile with said photochromic containing material.

Most preferably the method is used to form staple fibres for preparing needlefelt based industrial textiles which method typically includes the following steps of supplying a molten polymer mixture or blend by a metering pump to a spinneret so that a fibre with a denier of 1 - 40 is formed, then the extruded fibre is air quenched, optionally drawn and then cut to form staple fibre. Preferred deniers are 10 - 20.

The polymer matrix of the industrial textile of the present invention may comprise any polymer, blend or combination of polymers conventionally used in preparing industrial textiles and many particularly include any of the following materials (either alone, in blends or in combinations): polyester (PET, PBT, PPT, PTT, PEN, PBN, PCT, PCTA), aliphatic polyamides (PA6, PA6.6, PA12), aromatic polyamides (Kevlar (R.T.M.), Twaron (R.T.M.)), partially aromatic polyamides (Amodel, HTN, MXD6), liquid crystal polymers (Suprex, Vectran (R.T.M.)), polyacetones (Carilon (R.T.M.)), PEEK, PU, TPU, thermoplastic elastomers, PPS, PPO, PBO, polyamides, fluoropolymer (PTFE) polyolefin, (PP, PE). The weight ratio of photochromic masterbatch to polymer is generally 1: 10 - 20

whereby the masterbatch will comprise up to 0.1 - 100% by weight photochromic material and up to 99.9% by weight polymer, normally an encapulating material.

Certain industrial textiles may comprise at least one additional polymer matrix together with the polymer matrix comprising at least one photochromic material. For example a second polymer matrix may be provided as a polyamide and/or polyolefin staple fibre which is blended with a staple fibre containing photochromic material. Such a combination may be used to form a needle-felt based felt press for use in the paper making process, for example.

By the incorporation of particular photochromic materials in the polymer matrix of an industrial textile, wear of that particular textile may be simply detected. According to a third aspect of the present invention there is provided a method for detecting wear of a particular industrial textile according to the first aspect of the present invention wherein the photochromic material(s) of that industrial textile exhibit a particular colour change on exposure to a particular wavelength of light, comprising the steps of exposing shedded industrial fibres to that wavelength of light and comparing the exhibited colour change of those fibres with that exhibited by the aforesaid industrial textile. In this manner those fibres shedded from a particular industrial textile may be distinguished from those fibres of other textiles by the particular colour change displayed and thus shedded fibres may be simply, yet effectively identified as those from a particular textile of

a particular manufacturer.

Thus, for example, products (such as paper sheets) produced by processes using industrial textiles according to the first aspect of the present invention, that are contaminated with shedded fibres may be exposed to the appropriate colour change inducing light. This would induce a detectable colour change in the fibres contaminating the product thus indicating the identity of the particular industrial textile and/or the manufacturer of the particular industrial textile responsible for shedding the fibres. Most conveniently the photochromatic materials incorporated in the polymer matrix are those which display a reversible colour change when exposed to ultra violet light. The ultra-violet light may be conveniently provided by a portable ultra violet radiation source such as a flash gun. A simple, yet highly effective fibre identification means is thus provided by the industrial textile and method according to the present invention.

The present invention is illustrated by way of example only with reference to the accompanying drawing in which:

Fig 1 shows a diagrammatical representation of a perspective view of a needlefelt-based press felt in accordance with the present invention.

With reference to figure 1 a needlefelt-based press felt 1 comprises a woven base cloth 2 having a batt of staple fibres 4 (individual fibres not shown) secured thereto by needling. The felt is then treated with aqueous resin solution 6. The resin-treated felt is then heat-treated at a temperature of at least 100°C so as to remove the water and the resin is subsequently

heat-set. This needlefelt-based press felt was prepared in the following way:

A batch containing polyethylene and 0.2 wt.% Reversacol Storm Purple (TRADE MARK) were blended at temperature of 200°C.

The blended material was then extruded at 220°C at an output of 0.5 kg per hour forming staple fibres which may be 15 denier.

The photochromic material containing staple fibres were then needled into a woven base cloth so forming a needle felt-based press felt.

By this process, the needlefelt-based press felt is made up of labelled fibres which exhibit photochromic behaviour. The fibres are yellow in the absence of ultra violet light and purple in the presence of ultra violet light.

It will be appreciated that the present invention is not intended to be restricted to the details of the above embodiments which are described by way of example only. In particular the photochromic material may be applied to or incorporated into any suitable industrial textile structure by any suitable means.

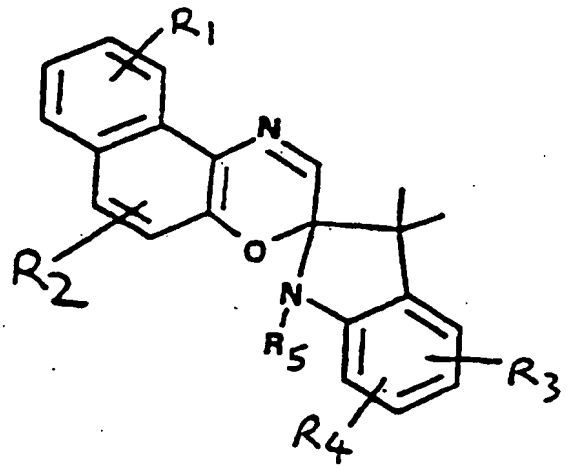
Claims

1. An industrial textile optionally having a coating thereon, wherein the textile and/or coating comprises a polymer matrix wherein the polymer matrix comprises at least one photochromic material.

2. An industrial textile according to claim 1 wherein the polymer matrix comprises 0.01 to 15% by weight of photochromic material.

3. An industrial textile according to any preceding claim wherein the photochromic material changes colour on exposure to ultra violet light.

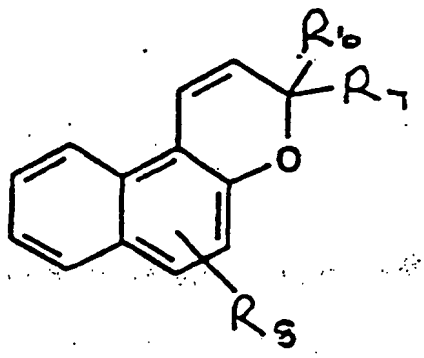
4. An industrial textile according to any preceding claim wherein at least one photochromic material is selected from a group of compounds represented by the following formulae:



where R_1, R_2, R_3, R_4 are each hydrogen, halogen or lower alkyl and R_5 is hydrogen or lower alkyl.

5. An industrial textile according to any preceding claim wherein at least one photochromic material is selected from a group of compounds

represented by the following formulae:



where R_6 and R_7 are optionally substituted aryl groups and R_8 is hydrogen, halogen or lower alkyl.

6. An industrial textile according to claim 5 wherein R_6 and R_7 are phenyl and R_8 is hydrogen, methyl or ethyl.

7. An industrial textile according to any preceding claim wherein the photochromic material is micro-encapsulated.

8. An industrial textile according to any claim 7 wherein the micro-capsule(s) comprise thermoplastic polymer material(s).

9. An industrial textile according to claim 7 or 8 wherein the micro-capsules are incorporated into the polymer matrix.

10. An industrial textile according to claim 6, 7 or 8 wherein thermoplastic polymer encapsulating material(s) is selected from a group comprising polyolefins, polyamides, and polyesters and mixtures thereof.

11. An industrial textile according to claim 6, 7, 8 or 9 wherein the encapsulating material preferably has a melt flow index greater than 15g/10 mins.

12. An industrial textile according to any preceding claim wherein the polymer matrix is provided as a fibre, filament and/or yarn or as a coating on a substrate.

13. An industrial textile as claimed in any preceding claim comprising at least one additional polymer matrix together with the polymer matrix comprising at least one photochromic material.

14. An industrial textile according to any preceding claim wherein the textile is needle-felt based.

15. An industrial belt comprising an industrial textile as claimed in any preceding claim.

16. A phase separation medium comprising an industrial textile according to any preceding claim.

17. A method for producing an industrial textile, the industrial textile optionally having a coating thereon wherein the textile and/or coating comprises a polymer matrix and wherein the polymer matrix comprises at least one photochromic material, which method comprises the steps of

(a) forming a blend of a polymer matrix and at least one photochromic material,

(b) melt-spinning or extruding that blend to form fibres/filaments/yarns or coatings containing photochromic

material(s),

(c) processing the fibres/filaments/yarns to form industrial textiles and/or coating an industrial textile with said photochromic containing material.

18. A method as claimed in claim 17 wherein in step (b) staple fibres are formed by melt-spinning and in step (c) the staple fibres are processed into a needle-felt based industrial textile.

19. A method for detecting wear of a particular industrial textile according to claims 1 to 14 wherein the photochromic material(s) of that industrial textile exhibit a particular colour change on exposure to a particular wavelength of light, comprising the steps of

(a) exposing shedded industrial fibres to that wavelength of light,

(b) comparing the exhibited colour change of those fibres with that exhibited by the said industrial textile.

20. A method according to claim 19 wherein the photochromic material(s) incorporated in the polymer matrix are those which display a reversible colour change when exposed to ultra violet light.

21. A method as claimed in claim 19 or 20 wherein the light is provided by a portable ultra violet radiation source.

22. An industrial textile substantially as hereinbefore described with reference to the accompanying drawing.

The Patent Office

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Application No: GB 9615385.3 **Examiner:** Alexander Littlejohn
Claims searched: 1-22 **Date of search:** 16 July 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): D01F 1/00, 1/02, 1/10; D03D 1/00, 15/00; D04H 1/42; D21F 1/00, 1/10, 7/08

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB1157609 (Heimbach) see e.g. page 2 lines 25-127	1,3,12,15, 16,17
X	US5422181 (Hwu) see whole doc.	1-18
X	US5403702 (Miyashita) see whole doc., especially col 5 lines 26-33	1-3,12-15
X	WPI Abstract Accession No. 95-135925/199518 & JP 070059646 A (Taiyo) 07.03.95 see abstract	1-3,12,13, 17
X	WPI Abstract Accession No. 92-295942/199236 & JP 040202811 A (Matsui) 23.07.92 see abstract	1-3,12-18
X	WPI Abstract Accession No. 91-183260/199125 & JP 030113014 A (Kuraray) 14.05.91 see abstract	1-3,12-18
X	WPI Abstract accession No. 90-293984/199039 & JP 020206411 A (Coteck) 16.08.90 see abstract	1-3,12,13
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